

Examiner's Amendment

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.
2. Authorization for this examiner's amendment was given in a telephone interview with **Attorney Thomas E. Kocovsky Jr. Reg. No. 54,446** on **Feb. 29th 2008** along with authorization to charge any necessary fees to applicant's deposit account.
3. The application has been amended as follows:

A) Replace claim 1 of the August 13th 2007 listing of claims with the following Examiner amended claim 1:

Claim 1 ---A magnetic resonance imaging system including:

a magnetic resonance imaging scanner configured to encode magnetic resonance in at least a readout direction, the encoding including applying a read magnetic field gradient profile;

a plurality of receive coils for receiving magnetic resonance signals;

a sampling means for sampling the receive coils during application of the read magnetic field gradient profile in order to acquire samples from each receive coil at a measurement sampling rate, wherein the sampling means undersamples the receive coils at a reduced sampling rate such that the intermediate reconstructed images include aliasing in at least the readout direction;

a means for reconstructing the magnetic resonance samples acquired from each coil into a corresponding intermediate reconstructed image, the intermediate reconstructed images having a measurement field of view and a measurement spatial resolution in the readout direction; and

a means for combining the intermediate reconstructed images based on coil sensitivity factors in order to produce a final reconstructed image having a final field of

view in the readout direction that is increased over the measurement field of view in the readout direction. ---

B) Replace claim 5 of the August 13th 2007 listing of with the following Examiner amended claim 5:

Claim 5 --- The magnetic resonance imaging system as set forth in **claim 4**, wherein the sampling means also acquires magnetic resonance samples encoded in the phase encode direction, the magnetic resonance imaging scanner and the receive coils cooperating in order to effect sensitivity encoding in the phase encode direction.---

C) Replace claim 9 of the August 13th 2007 listing of with the following Examiner amended claim 9:

Claim 9 --- A magnetic resonance imaging system including:

- a magnetic resonance imaging scanner configured to encode magnetic resonance in at least a readout direction, the encoding including applying a read magnetic field gradient profile;

- a sampler including a plurality of receive coils configured for receiving magnetic resonance signals and a sampling circuit configured for sampling the receive coils during application of the read magnetic field gradient profile in order to acquire samples from each receive coil, the sampling circuit acquiring samples in the readout direction that map to low frequency readout values of a k-space and not to higher frequency readout values of the k-space;

- a reconstruction processor configured to reconstruct the magnetic resonance samples acquired from each coil into a corresponding intermediate reconstructed image

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the intermediate reconstructed images having a measurement spatial resolution in the readout direction; and

a means for combining the intermediate reconstructed images based on coil sensitivity factors in order to produce a final reconstructed image having a final spatial resolution in the readout direction that is increased over the measurement spatial resolution in the readout direction. ---

D) Replace claim 17 of the August 13th 2007 listing of with the following Examiner amended claim 17:

Claim 17 --- A magnetic resonance imaging method including:

encoding magnetic resonance signals in at least a readout direction with a read magnetic field gradient profile;

sampling the magnetic resonance signals in the readout direction using a plurality of receive coils in order to acquire magnetic resonance samples from each coil at a measurement sampling rate undersampled in the readout direction;

reconstructing the magnetic resonance samples acquired from each coil into a corresponding intermediate reconstructed image, the reconstructed images having a measurement field of view in the readout direction and having aliasing in the readout direction due to the undersampling in the readout direction; and

combining the intermediate reconstructed images based on coil sensitivity factors in order to produce a final reconstructed image having a final field of view in the readout direction that is increased over the measurement field of view in the readout direction, the combining restoring field of view in the readout direction and removing the aliasing in the readout direction. ---

E) Replace claim 21 of the August 13th 2007 listing of with the following Examiner amended claim 21:

Claim 21 --- A magnetic resonance imaging method including:

encoding magnetic resonance signals in at least a readout direction with a read magnetic field gradient profile;

sampling the magnetic resonance signals in the readout direction using a plurality of receive coils in order to acquire magnetic resonance samples from each coil in the central region of k-space in the readout direction while completely omitting sampling of high readout k-values in the readout direction;

reconstructing the magnetic resonance samples acquired from each coil into a corresponding intermediate reconstructed image, the reconstructed images having a measurement spatial resolution in the readout direction; and

combining the intermediate reconstructed images based on coil sensitivity factors in order to produce a final reconstructed image having a final spatial resolution in the readout direction that is increased over the measurement spatial resolution in the readout direction and wherein the sampling is performed over a shortened read magnetic field gradient profile such that the combining restores resolution in the readout direction. ---

The following is an examiner's statement of **Reasons for Allowance**:

4. With respect to **Examiner independent claims 1, 9, 17 and 21**: these claims are considered to be allowable over the prior art of record because the prior art of record neither discloses nor suggests an MRI system/method comprising **undersampling** (i.e. claims 1, 17) / **sampling only in the low frequency readout values of k-space and not to higher frequency readout values of k-space** (i.e. claims 9, 21), in the

readout/frequency encoding direction, at a reduced sampling rate, wherein intermediate reconstructed images include aliasing in at least the readout direction, with the intermediate reconstructed images being combined based on sensitivity factors in order to produce a final reconstructed image having a final field of view in the readout direction, that is increased over the measurement field of view in the readout direction," in combination with the remaining limitations of each of the claims. It is the entire combination of the claim limitations taken as a whole that constitutes both the novelty and non-obviousness of applicant's claims.

5. With respect to **dependent claims 2-8, 10, 12-14 and 18-20**: these claims are considered to be allowable over the prior art of record because they each depend from an **allowable examiner amended independent claim**.

6. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Examiner's Comment

Priority

7. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Prior Art of Record

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

A) Zhu et al., US patent **7,009,396 B2** issued March 7th 2006, filed September 12th 2002.

B) Wang US patent **6,650,925 B2** issued November 18th 2003, with an effective US filing date of Feb. 8th 2002.

C) King US patent **6,242,916 B1** issued June 5th 2001, filed November 17th 1999.

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Conclusion

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tiffany Fetzner whose telephone number is: (571) 272-2241. The examiner can normally be reached on Monday, Wednesday, and Friday-Thursday from 7:00am to 2:10 pm., and on Tuesday and Thursday from 7:00am to 5:30pm.

10. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, **Dean Reichard**, can be reached at (571) 272-1984. **The only official fax phone number** for the organization where this application or proceeding is assigned is **(571) 273-8300**.

11. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PMR or Public PMR. Status information for unpublished applications is available through Private PMR only. For more information about the PMR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PMR system contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/TAF/
March 11, 2008

/Brij B. Shrivastav/
Primary Patent Examiner
Technology Center 2800